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THE PROBLEM OF ACID RAIN: IS THE PROTECTION OF PRIVATE PROPERTY RIGHTS THE SOLUTION?

P. MICHAEL WALKER*

I. INTRODUCTION

"Acid rain and other transported air pollutants . . . pose substantial risks to American resources."[1] Thus, the Office of Technology Assessment (OTA) has added its voice to the growing body of scientists, politicians and laymen who acknowledge that transboundary air pollution threatens our environment.[2] "Transboundary air pollution" refers to any pollutant which, when emitted, can travel long distances in the atmosphere, crossing political boundaries and affecting areas hundreds of miles from its source.[3] This article focuses on two pollutants of this type, sulfur dioxide (SO_2)[4] and nitrogen

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1. OFFICE OF TECHNOLOGY ASSESSMENT, ACID RAIN AND TRANSPORTED AIR POLLUTANTS: IMPLICATIONS FOR PUBLIC POLICY 3 (1984) [hereinafter cited as OTA REPORT].

2. *See generally* NATIONAL RESEARCH COUNCIL, ATMOSPHERE-BIOSPHERE INTERACTIONS: TOWARDS A BETTER UNDERSTANDING OF THE ECOLOGICAL CONSEQUENCES OF FOSSIL FUEL COMBUSTION (1981); SWEDISH MINISTRY OF AGRICULTURE, ACIDIFICATION TODAY AND TOMORROW (1982) [hereinafter cited as SWEDISH REPORT]; G. WETSTONE & A. ROSENCRANZ, ACID RAIN IN EUROPE AND NORTH AMERICA (1983); Bell, *Acid Rain*, 57 CONN. B. J. 261 (1983); Johnston & Finkle, *Acid Precipitation in North America: The Case for Trans-Boundary Cooperation*, 14 VAND. J. TRANSNAT'L L. 787 (1981); Likens, Wright, Galloway & Butler *Acid Rain*, SCI. AM., Oct. 1979, at 43; Rhodes & Middleton, *The Complex Challenge of Controlling Acid Rain*, ENVIRONMENT, May 1983, at 6; Wooley & Wappett, *Cumulative Impacts and the Clean Air Act: An Acid Rain Strategy*, 47 ALB. L. REV. 37 (1982); Note, *International-United States Air Pollution Control and the Acid Rain Phenomenon*, 21 NAT. RESOURCES J. 631 (1981).

3. *See, e.g.*, Johnston & Finkle, *supra* note 2, at 788.

4. Sulfur dioxide (SO_2) is emitted into the air by both natural and anthropogenic sources. Natural sources of emissions include ocean spray and decay processes of the soil. Anthropogenic emissions are caused by the combustion of fossil fuels, which contain sulfur as an impurity. About 26 million tons of man-made SO_2 are emitted per year in the U.S.; 22 million tons of which is emitted in the eastern 31 states. In heavily industrialized areas such as Eastern North America anthropogenic sources contribute 75 to 95% of total SO_2 emissions. On a nationwide basis, however, less than 5

oxides (NO_x),[5] the two primary causes of acid deposition.[6]

The debate over acid rain, like other environmental debates, centers around economic issues. Some experts argue that acid rain is causing extensive damage to our environment and economy and should be remedied immediately.[7] Others acknowledge that acid rain may cause some damage but argue that strict pollution controls would be an economic disaster and should not be undertaken until the process of acid deposition is better understood.[8] The proponents of this latter view point to projected increases in unemployment

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to 10% of sulfur emissions are attributable to natural sources. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 14; OTA REPORT, *supra* note 1, at 266.

5. Nitrogen oxides (NO_x) are also emitted by natural and anthropogenic sources. Natural sources of NO_x are primarily soil processes, organic decay and lightning. These sources represent 5 to 35% of the total NO_x produced in North America. Anthropogenic emissions result both from nitrogen bound in fuels and from compounds formed from nitrogen and oxygen in the air during combustion. Anthropogenic emissions totalled about 21 million tons of NO_x in the U.S. during 1980. Two-thirds of this total was emitted in the eastern 31 state region of the U.S. OTA REPORT, *supra* note 1, at 268.

6. An important distinction must be made here; acid deposition and transboundary air pollution are not synonymous. Acid deposition is a *result* of transboundary air pollution.

Acid deposition occurs when SO_2 and NO_x oxidize and combine with water to form acids. SO_x and NO_x may be oxidized in either the gas phase, after absorption into water droplets, or after dry deposition on the ground. These materials can be deposited on the ground unchanged as primary gaseous pollutants, or in a transformed state as secondary pollutants. Transformed pollutants can be deposited in wet form as rain, fog, or snow, or dry form due to particles containing these materials settling out. Thus, the term "acid rain," which is commonly used to describe acid deposition, is really a misnomer since acid deposition can occur in several other forms besides rain. For the sake of simplicity, however, the terms "acid deposition," "acid precipitation," and "acid rain" will be used interchangeably even though their meanings are slightly different. OTA REPORT, *supra* note 1, at 265-73. *See also* SWEDISH REPORT, *supra* note 2, at 30-44.

7. *See supra* note 2. The urgency of the proponents of this view seems bolstered by recent data which show that emissions of sulfur dioxide and nitrogen oxides may have started to rise again after a long period of decline. *Acidic Pollution Shows Rise in Early Data, E.P.A. Says,* N.Y. Times, Dec. 12, 1985, at 11, col. 1.

8. *See generally* Magnet, *How Acid Rain Might Dampen the Utilities,* FORTUNE, Aug. 8, 1983, at 58; Singer, *Acid Rain: A Billion-Dollar Solution to a Million-Dollar Problem?,* 27 POL'Y REV., 56 (1984); Vogtle, *Investigate, Educate Then Regulate,* 48 VIT. SPEECHES DAY 659 (1982); *Coal State Senators Say More Research Needed Before Enacting Acid Rain Controls,* [15 Curr. Dev.] ENV'T REP. (BNA) 399 (July 6, 1984); *Acid Rain Bill Poses 'Economic Destruction' for Appalachia, Mine Workers President Says,* [14 Curr. Dev.] ENV'T REP. (BNA) 2184 (March 30, 1984).

among Midwestern coal miners and increased electricity costs as examples of negative side effects of acid rain control.[9]

This article analyzes acid rain in a two-tiered approach. The first tier addresses the question, should acid rain be controlled, and if so, how strictly? The second tier, which assumes that acid rain is to be controlled, identifies the best method to implement the proposed controls. This article concludes that acid rain should be controlled for three reasons: it causes irreversible harm to the environment;[10] it constitutes the use of one's property to injure another's;[11] and it can harm people.[12] It also concludes that the most economically efficient method to solve acid rain is a free market system of air pollution entitlements governed by a common air quality constraint.[13]

II. SHOULD ACID RAIN BE CONTROLLED? — ITS IMPACT ON THE U.S. ECONOMY

A major issue in the debate over acid deposition is its effect on the U.S. economy. Industries such as the electric power industry claim that we do not know enough about the harm, if any, caused by acid deposition. Industrialists claim that it would be disastrous for the economy to impose emission controls without concrete evidence that sulfur and nitrogen oxides cause acid rain.[14] Conversely, environmentalists argue that the benefit of preserving natural resources and protecting against other harm caused by acid rain far outweighs the cost of the necessary pollution controls.[15] A review of recent economic and scientific data shows that acid rain causes serious harm to nature, some of which may be irreversible.[16] Acid rain may even cause harm to humans.[17] In monetary terms, this harm quite possibly exceeds the costs of its control.[18] The following sections illustrate the signifi-

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9. *See infra* note 167.
10. *See infra* notes 51-56 and accompanying text.
11. *See infra* notes 60-62 and accompanying text.
12. *See infra* notes 63-64 and accompanying text.
13. *See infra* notes 134-44 and accompanying text.
14. *See supra* note 8.
15. *See supra* note 2.
16. *See generally* OTA REPORT, *supra* note 1; R. RICE, THE EFFECTS OF ACID RAIN ON FOREST AND CROP RESOURCES IN THE EASTERN UNITED STATES (Sept. 1983) (The Wilderness Society, Wash., D.C.).
17. *See infra* notes 47-50 and accompanying text.
18. *Acid Rain Costs U.S. $5 Billion Annually,* NAT'L PARKS & CONSERV., July-Aug. 1983, at 42.

cant burdens imposed on American resources and the American economy by acid rain.

A. *Aquatic Resources*

When lakes and streams become acidic, they lose their ability to support aquatic life such as plants,[19] fish,[20] and amphibians.[21] When the acidity of water is greater than pH 5,[22] many fish species are eliminated.[23] The exact dollar value of the loss to fishing and related industries is difficult to determine, but one study estimates that New York resident fishermen lose approximately $1.7 million annually due to acidification of about two hundred Adirondack lakes and ponds.[24]

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19. Acidification impacts plant species that are at the base of the food chain, replacing them with a much less diverse collection of acid resistant species. Populations of important vertebrate species such as aquatic insects, freshwater snails, shrimp and mussels are all sensitive to acid conditions, possibly due in part to a reduction in algal food supply and in part to the susceptibility of larvae and invertebrate shells to acid conditions. Like the affected plants, these animals are important not only in their own right, but also as crucial parts of the food chain. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 30. *See also* OTA REPORT, *supra* note 1, at 41.

20. Fish populations are reduced or eliminated primarily because of reproductive failures, owing to the vulnerability of fish egg and fry to acidity. Sometimes fish die even in lakes that are not highly acidic. This effect is due to aluminum poisoning. As water becomes more acidic, the solubility of aluminum increases, and it is "precipitated in the form of aluminum hydroxide on the gills of the fish. The toxic mechanism is that the gills are damaged, the fish encounters greater difficulty in getting oxygen into its blood and it loses important salts that regulate the salt concentration in the body which ultimately leads to death or malformed development." G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 30-31; SWEDISH REPORT, *supra* note 2, at 64.

21. "Frogs, toads, and salamanders suffer dramatic population decreases and even local extinctions as a result of high acidity levels. These amphibians constitute an important food source for many birds and mammals. Hence, their loss may be felt higher in the food chain." G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 30.

22. The degree of a solution's acidity is determined by the concentration of unattached positively charged hydrogen ions and is measured in terms of "pH." The pH scale is a logarithmic scale based upon hydrogen ion concentration and ranges from 0 to 14. A pH of 1 is very acidic, a pH of 7 is neutral, and a pH of 14 is very alkaline. Because the scale is logarithmic, pH 5 is 10 times more acidic than pH 6, 100 times more acidic than pH 7, and so on. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 9.

23. OTA REPORT, *supra* note 1, at 213.

24. *Id.* at 82. Most of the economic data in this note are based upon the OTA REPORT. The majority of the OTA's estimates were based on in-house work. When interpreting these data, the OTA cautions that because of the substantial uncertainties associated with available data and theory

The secondary economic effects of the destruction of aquatic plants and animals which provide food to birds and mammals are also significant, but are very difficult to quantify.

Not all lakes and streams are threatened by acid rain.[25] The OTA has classified 25% of the land in the eastern thirty-one state region[26] of the United States as "sensitive;"[27] this land includes 17,000 lakes and 112,000 miles of streams. Of this figure, the OTA estimates that 9,500 lakes and 60,000 miles of streams might acidify given sufficient acid deposition, while 3,000 lakes and 23,000 miles of streams have already become acidified or have so little acid neutralizing capacity left that they are extremely vulnerable to further acidic deposition.[28]

B. *Terrestrial Resources*

The terrestrial resources most susceptible to acid rain are forests[29] and crops.[30] Forests are sensitive to acid deposition because of direct damage to trees[31] as well as harm

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the numerical descriptions given in the Report should be viewed as qualitative estimates, rather than exact, quantitative answers. The readers should not be misled by the apparent precision of the numbers. The information presented is intended to convey approximate outcomes—in some cases with unknown margins of error *Id.* at 41.

25. Several factors influence the susceptibility of lakes and water-courses to acidification. These factors include the ability of the soil to neutralize the acid (lime rich land areas protect the lakes whereas sandy soil and expanses of bare rock are mostly associated with acidified lakes and water-courses) and the extent and volume of surface runoff (acidic precipitation can be buffered when it penetrates into the ground, but if the ground is impermeable or if there are large quantities of runoff this buffering will not occur). SWEDISH REPORT, *supra* note 2, at 57.

26. Much of the OTA's economic information focuses on this region because it is responsible for 80-85% of all SO_2 and 65% of all NO_x emissions. OTA REPORT, *supra* note 1, at 126.

27. OTA defines "sensitive" land as that which allows the transport of acidity through a watershed to lakes and streams. *Id.* at 42.

28. *Id.* at 42-43.

29. The susceptibility of a forest area to acidification is dependent upon a number of factors including the tree species, the composition and moisture content of the soil, and the presence of bare rocks. SWEDISH REPORT, *supra* note 2, at 74-75.

For a discussion of the effects of acid rain on forests, see generally Hileman, *Forest Decline from Air Pollution,* 18 ENVIRON. SCI. & TECH. 84 (1984); Tomlinson, *Air Pollutants and Forest Decline,* 17 ENVIRON. SCI. & TECH. 246 (1983); Wetstone & Foster, *Acid Precipitation: What Is It Doing to Our Forests?* ENVIRONMENT, May 1983, at 10.

30. *See id.*

31. Direct damage would occur as a consequence of contact between

caused to the soil.[32] Trees, unlike crops, are long-lived species, and therefore are vulnerable to the long term chronic effects of acid rain.[33] The eastern thirty-one states contain three-quarters of the United States' commercial timberland, which represents $21 billion of the region's income. Thus, damage to forests is of vital concern. Large reductions in timber harvests could close paper and lumber mills and decrease exports of forest products.[34]

Several major agricultural regions of the United States are also subject to high levels of acid deposition. Scientists are trying to determine whether these levels affect crop productivity.[35] There has not been any observed damage to crops grown under natural conditions, but experiments using simulated acid rain have shown a deleterious effect on crop productivity and quality.[36] Since agriculture and related services provide $22 billion of the eastern states' income, damage to crops poses a significant potential risk to the U.S. economy.[37]

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acid deposition and the leaves by removing essential nutrient cations such as calcium directly from the tree foliage. "If the rate of nutrient loss is greater than can be replaced through the roots, nutrient deficiency will result." OTA REPORT, *supra* note 1, at 229.

"In addition, rainfall in the pH range of 3.0 to 4.0 has been shown to cause direct tissue injury (leaf necrosis) which can ultimately reduce forest growth. However, rainfall at such low pH levels is uncommon." G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 33.

32. The indirect effect of acid precipitation on trees caused by changes in the soil is more important than direct damage. Soil is made up of negatively charged humus and clay particles which can attach themselves to positively charged cations, such as calcium, magnesium, potassium and sodium. These cations are essential plant nutrients, picked up by forest tree roots and continuously replenished by the decomposition of fallen foliage and tree litter and the weathering of rocks. Acid deposition can upset this delicate balance. In the long term, pollution induced nutrient depletion accelerates the natural forest aging process, leading to the eventual exhaustion of the soil's ability to sustain tree growth. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 32-35.

33. OTA REPORT, *supra* note 1, at 44.

34. *Id.* at 89-90. Papermills are particularly vulnerable, since they represent large capital investments and must operate, in general, at over 90% of capacity to break even. *Id* at 227.

35. *Id.* at 218. Crops are more likely to be damaged through direct contact with acid deposition on above ground portions of plants than through soil-related effects because the chemistry of agricultural soils is already highly controlled with fertilizer and other chemicals. *Id.* at 43, 218.

36. *Id.* at 43.

37. *Id.* at 89.

C. *Material Resources*

Acid rain is one of a number of environmental factors[38] known to damage materials. Studies indicate that a broad range of materials including building stone and steel are affected by sulfur oxides and nitrogen oxides.[39] For most of these materials, SO_x and its transformation products—sulfates and sulfuric acid—are the chief man-made causes of damage.[40] However, since pollutants such as acid rain damage materials in ways that are not quantitatively different from natural weathering, it is difficult to estimate how much observed damage is due to acid rain. As a result, economic costs of acid rain are usually measured in terms of the amount it *accelerates* such degradation.[41] A recent draft report by the National Acid Precipitation Assessment Program estimates that the damage to buildings and materials due to acid rain approaches $7 billion in seventeen states.[42]

The risk posed to culturally and historically important resources is also of great concern. Historic monuments such as the Parthenon in Athens and the Colosseum in Rome have withstood weathering for hundreds of years without significant damage, but in recent years they have suffered serious decay.[43]

D. *Visibility Resources*

Visibility degradation is one of the most obvious effects

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38. Other environmental factors include humidity, temperature fluctuations, sunlight, salt, and microorganisms. *Id.* at 239.

39. *Id.*

40. Marble and limestone, for example, deteriorate when sulfur dioxide interacts with calcium carbonate, which forms a calcium sulfate crust that can crumble and be washed away. Sulfur dioxide and sulfuric acids may corrode protective coverings such as zinc, copper, nickel and aluminum and accelerate the corrosion of steel, iron and other metals. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 37.

41. OTA REPORT, *supra* note 1, at 239.

42. *Acid Rain Estimated to Cause $7 Billion in Damage to Materials Yearly in 17 States,* [16 Curr. Dev.] ENV'T REP. (BNA) 504 (July 26, 1985). Annual damage to paint and masonary in this region was estimated at $5 billion, the replacement of bronze and marble statues was estimated at $1.2 billion, and the damage to historic buildings was estimated at $1 billion. The 17 states included in the study were Connecticut, Delaware, Illinois, Indiana, Kentucky, Maine, Maryland, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia and West Virginia. Philadelphia receives the highest amount of damage to materials for the cities studied, approximately $339 million per year. *Id.*

43. SWEDISH REPORT, *supra* note 2, at 110.

of air pollution. Elevated levels of fine particulates such as sulfates and nitrates periodically create regional haze conditions.[44] Visibility impairment raises both aesthetic and practical concerns. Limited studies cited by the OTA suggest that visibility affects people's perceptions of air quality and property values in Los Angeles and the rural Southwest.[45]

The practical concerns of visibility impairment primarily involve transportation, particularly air traffic. Episodic regional haze in the East has been estimated to slow flight operations from 2 to 12% in the summer.[46] Haze can also restrict visual flight operations. The economic value of the beneficial effects of improved visibility are difficult to quantify, however.

E. *Human Health Resources*

Scientists have generally been unable to attribute adverse health effects to any single element of pollution, but one study estimates that about 2% (a range of 0 to 5%) of the deaths per year in the United States and Canada might be caused by airborne sulfates.[47] The range reflects the uncertain correlation between sulfates and mortality.

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44. The OTA Report defines "visibility" as including the following factors: general atmospheric clarity or haziness, the total distance over which objects can be seen, their apparent color and contrast with the sky, and discerned details of line, texture and form. OTA REPORT, *supra* note 1, at 244.

45. *Id.* at 47. Recent studies suggest that sulfates account for 70% of the visibility impairment during the summer, and 50% of the visibility impairment annually in the Eastern United States. *Id.*

46. *Id.* at 244.

47. *Id.* at 255. Sulfate particles are very small and can be readily inhaled into the lungs. Those at special risk from sulfate pollution are the elderly and adults with preexisting chronic heart or lung disease. Children also appear to be especially susceptible to increased lower respiratory-tract illness and decreased lung function. *Id.*

See also G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 39, citing studies that attribute to sulfate pollution between 50,000 and 150,000 deaths per year (about 2 to 6% of annual mortality); *50 Percent Drop in Sulfur Emissions Said to Reduce Deaths by 34,750 Annually,* [15 Curr. Dev.] ENV'T REP. (BNA) 1378 (Dec. 14, 1984).

NO_x health effects have not yet been investigated as much as SO_x health effects, and NO_x pollution *per se* has not been associated with adverse effects at common exposure levels. Studies have associated exposures to high NO_x levels with bronchitis and pneumonia, however. NO_x pollution also contributes to the formation of oxidant gas, which has been associated with respiratory irritation, as well as heart disease. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 39.

Acid rain may also cause indirect adverse effects on human health.[48] One way acid rain can affect human health is through the contamination of drinking water. Acid rain may scavenge or leach toxic materials on its way to a water supply.[49] These toxic materials would contaminate the water supply. However, scientists have not yet discovered a causal relationship between acid deposition and drinking water quality.[50]

F. *An Ethical and Moral Analysis*

In addition to the economic reasons stated above, acid rain should be controlled for moral and ethical reasons. First, acid rain causes irreversible harm to the environment.[51] This irreversible harm is morally wrong because man has a duty, as a steward of God's land, to preserve the land intact for future generations. The principle of stewardship has its roots in the Bible:[52] "The earth is the Lord's, and the fullness thereof."[53] But while the earth belongs to God because He created it, the earth also belongs to man: "[T]he highest heavens belong to the Lord, but the earth He has given to man."[54] Therefore, man's dominion over the earth does not belong to him by right, but only by God's favor. The earth "belongs" to man not because he made it, but because its Maker has entrusted its care to him. Thus, man is only the steward of God's land, and holds that land in trust for Him. As trustee, man must manage the land and other natural resources responsibly and productively for the sake of current and subsequent generations.[55] Pope John Paul II has added, "human Christian values triumph . . . when the environment is preserved intact for future generations."[56] When man does

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48. OTA REPORT, *supra* note 1, at 259.

49. *Id.*

50. *Id.*

51. Efforts at restoring water quality using processes such as liming have had limited success, since not all lakes and streams respond to liming. In those lakes, aquatic life has not been restored. Also, the long-term ecological effects of liming are unknown. OTA REPORT, *supra* note 1, at 21.

52. *See* J. STOTT, ISSUES FACING CHRISTIANS TODAY (1985); Berry, *The Gift of Good Land*, SIERRA, Nov.-Dec. 1979, at 20; Hefley, *Christians and the Pollution Crisis*, 71 MOODY MONTHLY 19 (1970); LaBar, *A Message to Polluters From the Bible*, CHRISTIANITY TODAY, July 26, 1974, at 8.

53. *Psalms* 24:1.

54. *Psalms* 115:16.

55. *Numbers* 36:1-12.

56. John Paul II, Address to the People of Philadelphia (Oct. 3, 1979), *reprinted in* 9 ORIGINS 309 (1979).

not protect the environment from irreversible harm, he not only manages his resources irresponsibly, but he despoils the earth for future generations.

This argument is not to be equated with absolute protectionist arguments which assert, for example, that the environment should be protected just because it is important to have beautiful lakes and streams,[57] or because plants and trees are moral agents.[58] A certain amount of pollution is justifiable—that amount which does not cause irreversible harm to the environment. Further, this argument for environmental protection is not based on an argument for corporate social responsibility.[59]

A second line of ethical reasoning for preventing harm to the environment is the property law principle *sic utere tuo ut alienum non laedas*—it is wrong to use one's property to harm the property of another.[60] A property owner "has the right to the reasonable use and enjoyment of his own property, [but] he may not so use it as unreasonably to deprive an adjacent owner of use and enjoyment of his property."[61] A property use is appropriately allowed only where the use is "a reasonable exercise of the dominion which the owner of the property has by virtue of his ownership over his property, having regard to all interests affected, his own and those of his neighbors, and having public policy in view also."[62] The use of property to pollute the air, impair visibility, and cause damage to another's crops, buildings and other materials, is a violation of this principle.

The third ethical reason for controlling acid rain is concern for human dignity, an important theme in Christian teaching.[63] According to Pope John Paul II, "human Christian values triumph by subjecting political and economic considerations to human dignity, making them serve the cause of every man — every person created by God, every brother

57. *See, e.g.*, Colwell, Jr., *The Balance of Nature: A Ground for Human Values*, MAIN CURRENTS IN MODERN THOUGHT 26, 50 (1969).

58. *See, e.g.*, Goodpaster, *From Egoism to Environmentalism*, in ETHICS AND PROBLEMS OF THE 21ST CENTURY 21 (K. Goodpaster & K. Sayre eds. 1979). For a general discussion of the variety of ethical approaches to environmental issues, see Frankenna, *Ethics and the Environment*, in *id.* at 3.

59. *See generally* CATHOLIC SOCIAL TEACHING AND THE U.S. ECONOMY (J. Houck & O. Williams eds. 1984).

60. 1 AM. JUR. 2D *Adjoining Landowners* § 2 (1962).

61. *Id.*

62. *Id.*

63. *See, e.g.*, STOTT, *supra* note 52, at 144.

and sister redeemed by Christ."[64] Individual human dignity demands concern for the health hazards of acid rain.

III. Existing Legal Means to Control Transboundary Air Pollution

Interstate air pollution is currently legally controlled by federal regulations or public and private lawsuits. For different reasons, neither of these mechanisms have protected the environment. This section analyzes why these approaches, as currently applied, fail to adequately address the problem of acid rain.

A. *Federal Regulation — The Clean Air Act*

1. An Overview

The Clean Air Act[65] is the federal regulatory scheme designed to control air pollution.[66] The Act, as currently written, is an ineffective means to control transboundary air pollution.[67] An overview of the current law will be presented before the weaknesses of the Act are explored.

The purpose of the Act is to "protect and enhance the quality of the Nation's air resources so as to promote public health and welfare and the productive capacity of its population."[68] To achieve this purpose, the Act requires the Administrator of the Environmental Protection Agency (EPA) to promulgate national primary and secondary ambient air quality standards (NAAQS) for certain criteria air pollutants.[69]

Each State is responsible for the "implementation, maintenance, and enforcement" of both the primary and secondary NAAQS in the Air Quality Control Regions (AQCRs)[70]

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64. John Paul II, *supra* note 56, at 309.

65. 42 U.S.C. §§ 7401-7626 (1982).

66. The Acid Precipitation Act of 1980, 42 U.S.C. §§ 8901-8905 (1982), also addresses the problem of air pollution. This Act only establishes a research program for acid rain, however, and provides no remedies for its abatement.

67. *See supra* note 2.

68. 42 U.S.C. § 7401 (b)(1) (1982).

69. *Id.* § 7408-7409. NAAQS currently exist for six pollutants: sulfur dioxide, nitrogen dioxide, ozone, total suspended particulates, carbon monoxide and lead. OTA Report, *supra* note 1, at 105.

70. An AQCR is "an interstate or intrastate area which, because of common meteorlogical, industrial and sociological factors, should be treated as a single unit for the purposes of air pollution control." Frick, *Air Pollution Control,* in Environmental Law Handbook 148 (7th ed. 1983) [hereinafter cited as Environmental Law Handbook].

within its jurisdiction through the administration of a State Implementation Plan (SIP).[71] Under the SIP, new sources of pollution are required to meet New Source Performance Standards (NSPS)[72] which set a maximum pollution emission rate for each source based upon the best available technology. Existing sources are limited to an amount of emissions that would allow a particular AQCR to meet the NAAQS.[73]

The Act divides the country into two areas: those that meet the NAAQS ("attainment" areas) and those that do not ("nonattainment" areas).[74] Any new stationary source that wishes to locate in an attainment area is subject to Prevention of Significant Deterioration (PSD) regulations.[75] Before a new source of emissions may be constructed, PSD requires the source to demonstrate that it has or will meet the following conditions:

1. it will not cause a violation of the NAAQS;[76]

2. it will not cause a violation of the statutory PSD increments;[77]

3. it will employ "Best Alternative Control Technology" (BACT);[78]

4. an analysis of air quality impacts on visibility, soil, and vegetation has been performed and;[79]

5. a public review will be held on the proposed

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71. 42 U.S.C. § 7410 (1982).

72. *Id.* § 7411. The original purposes of NSPS were to reflect the fact that new plants could incorporate new control technology easier than old plants could, and to establish the same control on all new sources in a particular category so that states could not try to attract new industry by relaxing emission controls. ENVIRONMENTAL LAW HANDBOOK, *supra* note 70, at 165-66. For a further discussion of NSPS, see 1 F. GRAD, TREATISE ON ENVIRONMENTAL LAW 2-269 (1984) and ENVIRONMENTAL LAW INSTITUTE, AIR AND WATER POLLUTION CONTROL LAW: 1982 at 159 (1982) [hereinafter cited as ELI REPORT].

73. 42 U.S.C. § 7411(d) (1982).

74. *Id.* § 7407(d). A nonattainment area is defined as an area that has not achieved the NAAQS. For a further discussion of nonattainment, see ELI REPORT, *supra* note 72, at 49.

75. 42 U.S.C. §§ 7470-7476 (1982).

76. *Id.* § 7475(a)(3).

77. *Id.* PSD increments are the maximum allowable increases over baseline concentrations for a pollutant. *Id.* § 7473(a). The term "baseline concentration" of a pollutant is "the ambient concentration levels which exist at the time of the first application for a permit in an area" subject to PSD. *Id.* § 7479(4).

78. *Id.* § 7475(a)(4).

79. *Id.* § 7475(a)(6).

construction.[80]

BACT is defined as "a case by case determination of the maximum emission reduction achievable by the facility for each pollutant regulated by the Act, taking into consideration the cost, energy, non-air environmental impacts and other factors. BACT cannot be less stringent than NSPS."[81]

Any new stationary source that wishes to locate in a nonattainment area must undergo preconstruction review to determine if the source will meet SIP requirements;[82] it must be controlled by Lowest Achievable Emission Rate (LAER) technology;[83] and it must show that other sources owned or operated in the state by the applicant are in compliance or on a compliance schedule to meet existing emission limitations.[84] LAER is defined as that technology which is either the most stringent limitation in any SIP or is the lowest emission level that any source in that industrial category has achieved in practice.[85] Existing sources in nonattainment areas are required to install through their state SIP, at a minimum, "reasonably available control technology." Furthermore, they are required to make "reasonable further progress" towards attainment of NAAQS.[86]

The existing approach to the Act is what is termed a "command and control" approach—that is, "a regulatory scheme based on rules which apply specific uniform emission limits — generally based on known feasible control technology — to every emission point within a regulated process."[87] The command and control approach is an expensive way to implement clean air goals for three reasons: (1) the conventional system's tendency towards uniform percentage reduction requirements for all dischargers within an industry; (2) the de facto requirement that new sources of air pollution install specific technology to abate their pollution; and (3) the selection of industry-specific controls on the basis of affordability and on information concerning that industry

80. *Id.* § 7475(a)(2).
81. ENVIRONMENTAL LAW HANDBOOK, *supra* note 70, at 163.
82. 42 U.S.C. § 7502(b)(6) (1982).
83. *Id.* § 7503(2).
84. *Id.* § 7503(3).
85. *Id.* § 7501(3).
86. *Id.* § 7503(b)(3).
87. U.S. GENERAL ACCOUNTING OFFICE, A MARKET APPROACH TO AIR POLLUTION CONTROL COULD REDUCE COMPLIANCE COSTS WITHOUT JEOPARDIZING CLEAN AIR GOALS (1982) [hereinafter cited as GAO REPORT].

alone.[88]

2. Problems with the Act

Congress recognized the potential problem of pollution from one state affecting the air quality in a nearby state, and amended the Act in 1977 by adding provisions to abate interstate pollution. Section 110(a)(2)(E)[89] requires a SIP to contain provisions to prevent a source within a state from emitting pollutants that would inhibit another state from achieving the NAAQS[90] or PSD[91] requirements. Section 126[92] of the Act allows states to petition the Administrator of EPA for a finding that any major source emits or would emit any pollutant that would prevent the petitioning states from achieving the NAAQS or PSD requirements.[93]

Flaws in the NAAQS and the interstate provisions of the Act prevent them from effectively deterring acid precipitation.[94] The NAAQS do not include sulfates and nitrates, the actual components of acid rain, as criteria pollutants.[95] Many areas showing a decrease in sulfur oxides over time also show an increase in sulfates and acid rain.[96] Thus, since sulfates and nitrates are not monitored under the SIPs, acid precipitation is not adequately controlled.

Another flaw in the Act is its assumption that pollutants tend to stay in the area from which they were emitted.[97] The Act measures and regulates air pollution in terms of ambient air quality at ground level.[98] However, the emissions of sulfur oxides which form sulfates may travel hundreds of miles in the atmosphere from their point of emission.[99] Furthermore,

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88. *Id.* at 20.
89. 42 U.S.C. § 7410(a)(2)(E) (1982).
90. *Id.* § 7410(a)(2)(E)(i)(I).
91. *Id.* § 7410(a)(2)(E)(i)(II).
92. *Id.* § 7426.
93. *Id.* § 7426(b).
94. *See* Lee, *Interstate Sulfate Pollution: Proposed Amendments to the Clean Air Act*, 5 HARV. ENVTL. L. REV. 71 (1981).
95. *See, e.g.*, G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 98; Note, *Coal v. Clean Air: A Transboundary Dispute*, 86 DICK. L. REV. 753, 776 (1982).
96. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 98.
97. *See, e.g.*, Hartman, *Alternatives for Regulatory Control of Acid Rain in the Northeastern United States*, 11 FORDHAM URB. L. J. 455, 469 (1983).
98. *See* 40 C.F.R. § 50.1(e)(1982).
99. Two factors that influence how far the pollutants travel from their point of emission are residence time in the atmosphere (which is influenced by the stack height of the emission source) and weather patterns.

transformation of sulfur oxides to sulfates and acid rain takes time.[100] Thus, measurement of ambient air quality may be misleading and thus may not abate transboundary air pollution.

The transboundary provision of the 1977 Amendments, section 110(a)(2)(E), is also limited in its ability to control interstate pollution; it applies only to air pollution, not directly to acidic deposition.[101] It gives little guidance as to how much interstate pollution is prohibited, and does not outline the level of proof required to substantiate regulation by the EPA.[102] In practice, section 126 has also been ineffective in dealing with transboundary air pollution. At least nine petitions from Pennsylvania and Maine were consolidated into a single proceeding before the EPA. These petitions alleged that sources in Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia and Tennessee emitted pollutants in violation of section 110(a)(2)(E) of the Act. The Administrator of the EPA recently denied these petitions.[103]

B. *Public and Private Lawsuits*

The second approach to preventing acid rain has been through public and private lawsuits. The public lawsuits[104] have been brought under the federal common law of nuisance.[105] In 1972, for example, the Supreme Court allowed a nuisance action to abate interstate pollution problems in *Illinois v. City of Milwaukee (Milwaukee I).*[106] In that action, the State of Illinois alleged that four Wisconsin cities and two sewerage districts were polluting the interstate waters of Lake Michigan. The Court held that federal common law

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There are documented cases where emissions have travelled distances exceeding 1000 kilometers. G. WETSTONE & A. ROSENCRANZ, *supra* note 2, at 15.

100. *See, e.g.*, OTA REPORT, *supra* note 1, at 267.

101. *Id.* at 300.

102. *Id.*

103. *EPA Denies Northeast States' Petitions Asking for Action on Emissions in Midwest,* [15 Curr. Dev.] ENV'T REP. (BNA) 1326 (Dec. 7, 1984).

104. *See* Lutz, *Interstate Environmental Law: Federalism Bordering on Neglect?,* 13 SW. U.L. REV. 573 (1983); Post, *Federal Common Law Suits to Abate Interstate Air Pollution,* 4 HARV. ENVTL. L. REV. 117 (1980).

105. Federal common law is "a body of decisional law developed by the federal courts untrammeled by state court decisions." BLACK'S LAW DICTIONARY 550 (5th ed. 1979). *See* Friendly, *In Praise of Erie—and the New Federal Common Law,* 39 N.Y.U. L. REV. 383 (1964); Note, *Federal Common Law,* 82 HARV. L. REV. 1513 (1969).

106. 406 U.S. 91 (1972).

supplements federal statutory law in cases involving interstate air and water pollution. But in the subsequent case of *City of Milwaukee v. Illinois (Milwaukee II)*,[107] the Supreme Court restricted the reach of federal common law. The Court held that since a federal statutory scheme was in place to prevent interstate water pollution, it preempted a federal common law remedy. Thus, any present suits brought under the federal common law of nuisance to abate interstate air pollution would probably fail because the Act makes provisions for preventing this type of pollution.[108] While it may be argued that the actual precursors of acid rain, sulfates and nitrates, are not directly controlled by the Act, it is unlikely that federal common law can be used to fill this gap in the law.[109]

Private actions[110] to control transboundary air pollution are available through federal or state laws. The Clean Air Act, for example, contains a provision for citizens' suits.[111] These suits are subject to relaxed standing requirements,[112] but the plaintiff still faces the difficult burden of proving actual damage or injury.

Private causes of action brought under state law include trespass, nuisance, negligence, and strict liability.[113] The Act specifically prohibits federal preemption of these common law remedies.[114] The plaintiff in these suits has the difficult task of selecting a defendant.[115] Even if the plaintiff can select

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107. 451 U.S. 304 (1981).

108. *See supra* notes 89-93 and accompanying text.

109. *See* Lutz, *supra* note 104, at 607.

110. *See generally* Crawford, *The Problems of Causation in Private Legal Remedies for Damage from Acid Rain*, 17 NAT. RESOURCES LAW. 413 (1984); Fischer, *The Availability of Private Remedies for Acid Rain Damage*, 9 ECOLOGY L.Q. 429 (1981); Mingst, *Evaluating Public and Private Approaches to International Solutions to Acid Rain Pollution*, 22 NAT. RESOURCES J. 5 (1982); Comment, *Proof of Causation in a Private Action For Acid Rain Damage*, 36 ME. L. REV. 117 (1984); Note, *Compensating Private Parties for Transnational Pollution Injury*, 58 ST. JOHN'S L. REV. 528 (1984) [hereinafter cited as Note, *Compensating Private Parties*]; Note, *Acid Rain—The Limitations of Private Remedies*, 1983 S. ILL. U.L.J. 515; Note, *Environmental Law—the Nuances of Nuisance in a Private Action to Control Air Pollution*, 80 W. VA. L. REV. 48 (1977).

111. 42 U.S.C. § 7604, 7607 (1982).

112. *Id.* § 7604 (a) (eliminating the requirements of the amount in controversy and diversity of the parties).

113. *See, e.g.*, Comment, *supra* note 110, at 535.

114. 42 U.S.C. § 7604(e) (1982).

115. Acid rain usually originates in areas containing many sources of emissions. Establishing the necessary relationship between causation and damage will require extensive expert opinion and data, often a very expen-

a defendant or group of defendants under a market share liability analysis, the plaintiff has the further burden of establishing the causation between the injury he has suffered and the offending activities of the defendant.[116] Proof of this nexus may be very difficult when the offending pollutants have come from sources hundreds of miles away. Finally, the remedies available in such suits are often inadequate. The relief is usually limited to compensation for both the past and future damage suffered by the plaintiff, but does not address the heart of the problem: abating the source of the emissions.[117]

C. *Summary*

Because of the transboundary nature of acid rain, only a federal regulatory scheme will provide an effective remedy. Public lawsuits based upon the federal common law of nuisance no longer seem viable under the *Milwaukee II* decision. Private lawsuits face procedural difficulties, and even when successful do not usually provide adequate relief. A revamped Act accompanied by effective enforcement is necessary to protect natural resources from further harm.

IV. The Best Method to Implement Pollution Controls — Providing Incentives to Abate Acid Rain

The second tier of the two-tiered analysis of acid rain is identifying the best method to implement pollution controls. As previously discussed, a federal regulatory scheme, such as the Clean Air Act, is necessary to begin to alleviate the acid rain problem. Unfortunately, several sections of the current Act prevent its effectiveness.[118] Prior to evaluating ways to enhance the Act's effectiveness, some principles of property law will be examined to illustrate the fallacies upon which the current law is based. After the proper foundational principles of an effective control policy are established, the details of a specific air pollution control law will be set forth.

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sive and time-consuming endeavor. Lutz, *supra* note 104, at 614. *See generally* Crawford, *supra* note 110.

116. Crawford, *supra* note 110, at 423-24. Market share liability shifts the burden of showing who caused the damage complained of from the plaintiff to the defendant. *Id.*

117. Rarely is the nuisance enjoined, and the possibility of obtaining injunctive relief in one state that would be enforceable in another is unlikely. Lutz, *supra* note 104, at 614.

118. *See* notes 89-93 and accompanying text.

A. *Property Rights and Pollution*

There are two opposing systems of property rights: a common property system where rights are treated as free and can be exercised by everyone, and a private property system where such rights are exclusive.[119] The results of the use of resources under these systems are remarkably different, primarily because of the incentives present in each system.[120]

When property, such as air, is held in common by those who use it, the result is overexploitation. This problem has been called "the tragedy of the commons."[121] The tragedy of the commons arises because the rational man finds that the loss to his health and environment when he pollutes the air is less than the loss he would experience if he had to pay for the costs of controlling that pollution. As one commentator has said:

> Therein lies the tragedy. Each man is locked into a system that compels him to [pollute] without limit - in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his best interest in a society that believes in the freedom of the commons. Freedom in the commons brings ruin to all.[122]

The problem of overexploitation in a communal property system could possibly be avoided by an agreement among the members of the community which would protect resources from overuse, but there are high transaction costs involved in negotiating such an agreement.[123] Further problems, such as hold outs and policing the agreement, also detract from the attractiveness of a communal property system.[124]

A private property system, on the other hand, creates incentives for the property owner to use his resources more efficiently. In order to maximize his wealth, the owner must consider not only the value of his property in the present, but also the effect of his actions on the future value of the property. This highlights the primary disadvantage of communal property: the effects of a person's activities on his neighbors

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119. Demsetz, *Toward a Theory of Property Rights,* 57 AM. ECON. REV. 347 (1967).
120. *Id.*
121. Hardin, *The Tragedy of the Commons,* 162 SCIENCE 1243 (1968).
122. *Id.* at 1244.
123. Demsetz, *supra* note 119, at 354-55.
124. *Id.* at 355.

and on subsequent generations are not fully taken into account.[125]

Private property rights, which are the foundation of a free market, private property system, are therefore important to safeguard if our resources are to be protected intact for future generations.[126] It is precisely the failure to protect these rights that has led to the pollution that exists today.[127] As one commentator has noted:

> The existence of pollution in a "free enterprise system" is not proof that the market system is characterized by externalities and a condemnation of the system; instead it is proof that the system is not a private property, free market system. Rather than being an example of market failure, it is an example of governmental failure. It is the failure of the government and the courts to protect the system of private property rights upon which a private enterprise economy is founded.[128]

Indeed, the desire for rapid economic development in the nineteenth century was responsible for the government and the courts impugning these private property rights.

> If instead, A's pollution of B's property had been treated as an invasion of B's rights, and the courts had allowed B to collect damages or enjoin A from any further invasions, we would have had the development of a free market, private property economic system, which would have been a system characterized by far less pollution than we now have.[129]

B. *Reworking the Act—An Economic Incentive Approach to Air Pollution Control*

The preceding analysis provides a theoretical basis for remodeling the Act. That is, in order to protect our environment from irreversible harm, we must find a way to protect a person's private property rights. A Clean Air Act that incorporates a free market system of air pollution control is the best avenue to respect and protect these rights.

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125. *Id.*
126. Smith, *Privatizing the Environment,* 20 POL'Y REV. 11, 30-31 (1982).
127. *Id.* at 25.
128. *Id.* at 26.
129. *Id.* at 25.

1. The Free Market System of Air Pollution Control

Simply phrased, a free market system of air pollution control is a free market system of air pollution entitlements, that is, a system of "entitlements to legal exploitation."[130] These rights to pollute would be governed by a common restraint governing air quality, such as NAAQS. Each polluter would be "entitled" to emit a certain amount of pollutants based upon the NAAQS limit.[131] The polluter would be allowed to meet this level of emission any way he chose, possibly by installing pollution control equipment, switching fuels, coal washing, or even by paying another polluter to reduce the amount of his emissions by an amount sufficient to bring the first polluter in compliance with the NAAQS.

The common restraint on air quality is necessary because of the inherent nature of air.[132] Air, as a resource, does not neatly fit into the tragedy of the commons analysis because unlike other resources, such as trees or herds of animals, there is no way to "fence in" air. Since no one can be excluded from its use, air has been overexploited.[133] Thus, it is necessary to have the government impose an overall restraint on the use of air. Once that overall restraint has been established, air (that is, the *use* of air) can be considered excludable private property.

This system of air pollution control may be designated as "regulatory," but it is regulation in its weakest form. It is actually an incentive system. The term "regulation" carries with it the connotation of a very rigid, inflexible control. As used here, however, it means a very decentralized, flexible system that leaves most of the decisions regarding pollution controls to the individual polluter.

2. A Free Market System of Air Pollution Entitlements Should be Implemented

An entitlement system is attractive primarily because it enhances economic efficiency. In a 1982 report, the Government Accounting Office (GAO) concluded that in a free market entitlement system, the savings in abatements costs for particulate emissions range from about 40 to 90%.[134] An-

130. GAO REPORT, *supra* note 87, at 22-24, 46.
131. *Id.*
132. *Id.* at 36.
133. *Id.* at 46.
134. *Id.* at 34.

other important factor is the dynamic savings[135] a free market would produce. When the burden is on the polluter to achieve his pollution reductions any way he chooses, he has the incentive to choose the least costly method. In the attempt to find the least costly method, research into new and better methods of pollution control may be stimulated. These new methods would lower the cost of pollution control to industry. The present Act has failed in its attempt to produce this "technology forcing" effect, although such an effect was a primary goal of the 1977 Clean Air Act Amendments.[136]

The free market system of air pollution entitlements approach would also improve enforcement of air pollution controls.[137] Since companies are paying for their rights to pollute, they would have the incentive to protect their property rights. They would be damaged by other companies polluting in violation of their entitlements because the latter would not be bearing the burden of paying for the control of their emissions. This improvement in enforceability is very important, especially in light of the alarming statistics that show the poor enforcement of the current Act. For example, the GAO determined that only 25% of the major sources were found in compliance by the most reliable methods and 72% were certified by states based on unverified information or information supplied by the sources. The EPA also found that of 921 inspections of sources supposedly in compliance, 200 or 22% of these were in violation.[138]

Another problem closely related to enforcement is the accuracy of air quality monitoring networks.[139] Reliable air pollution emission data are important for two reasons: they are needed to develop an adequate and reliable air quality modeling plan and they are necessary to determine compliance with the Act.[140] The GAO reported that "72 percent of the air quality monitors which it evaluated were incorrectly placed; that about 60 percent of the monitoring equipment in use was not certified by EPA; and, that 81 percent of the

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135. Static cost savings are savings based on existing pollution control technology. Dynamic cost savings are savings due to advances in pollution control technology. *Id.* at 30-31.

136. *See* Note, *Forcing Technology: The Clean Air Act Experience,* 88 YALE L.J. 1713, 1714 (1979).

137. GAO REPORT, *supra* note 87, at 43.

138. *Id.* at 44.

139. *Id.* Monitoring networks measure the air quality in different areas throughout the country. *Id.*

140. *Id.*

monitoring sites had problems which could result in unreliable data."[141] The information contained in these two GAO studies is alarming and shows that the present Act is woefully deficient in enforcing existing clean air standards.

The free market solution is also desirable from a moral and ethical perspective. Irreversible harm to the environment and damage to other persons' property will be prevented by setting sufficiently strict NAAQS. This solution also respects human dignity because it imposes the lightest economic burden on society. When polluters choose the least costly method to control acid rain, it is quite likely that as part of that choice, the company will switch from using high-sulfur coal to low-sulfur coal.[142] This may result in a loss of jobs among Midwestern coal miners.[143] One might argue that a pollution control scheme that puts people out of work shows a *lack* of respect for human dignity and that a choice of a least cost solution is pure utilitarianism.[144] The view expressed here is not one of moral agnosticism, however. Rather, it recognizes many values—the inherent right to a job, the value of keeping families together, the inherent value of letting people make decisions to the point where they are economically efficient—and concludes that there is no way to choose among them. The values on both sides are so similar that market price becomes the determinative factor. This approach is a practical one; however, it is also true that price, in some way, reflects these conflicting values, and by choosing the most economically efficient method of pollution control, we are making an ethically and morally sound choice.

3. Controlled Trading — EPA's Attempt at a Free Market

The EPA recognized the potential benefits of free market incentives for air pollution control when it adopted its "controlled trading" policy through the Clean Air Act Amendments of 1977.[145] Controlled trading is a limited mar-

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141. *Id.*

142. The reason polluters would switch to low-sulfur coal is because it is a way to reduce SO_2 emissions without incurring any costs. A technological solution, on the other hand, would require large capital investments.

143. *See, e.g.*, OTA REPORT, supra note 1, at 50.

144. Utilitarianism may be defined as "the ethical attitude which seeks to produce the greatest good for the greatest number." C. CURRAN, THEMES IN FUNDAMENTAL MORAL THEOLOGY 121 (1977).

145. *See, e.g.*, GAO REPORT, *supra* note 87, at 12.

ket in air pollution entitlements. The market is "limited" because firms are still constrained by other provisions of the Act, even though they are allowed to find cheaper ways to control air pollution.[146] Controlled trading is a precursor to a full-scale market system of air pollution entitlements.[147] Controlled trading must thus be analyzed to determine how it might be modified to achieve a full-scale free market system.

Controlled trading[148] consists of three programs: the bubble policy, the offset policy, and emissions reduction banking. These programs are subject to the same air quality standards as the Act.[149]

The bubble policy[150] places an imaginary bubble over an industrial plant. The emissions from the plant are deemed to come from only one source, a single "stack" at the top of the bubble. Individual sources of emissions within the plant may violate emission limits, but as long as the aggregate emissions from the plant meet acceptable levels, the plant is in compliance. Prior to the 1977 Amendments to the Act, each source of emissions within the plant had to meet the air quality standards.[151] Under the bubble policy, a plant will first roll back its emissions from the individual sources within the plant that are cheapest to control. EPA has expanded the bubble policy to cover more than one plant, recognizing that it might be cheaper for one plant to strictly control its emissions and for another plant not to control its emissions at all, such that the aggregate sum of emissions is still lawful. Otherwise, both plants would have to roll back emissions to a certain specified level.[152]

The offset policy[153] allows new plants in nonattainment[154] areas provided that they offset their emissions with

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146. *See* text accompanying notes 157-59 *infra*.

147. GAO REPORT, *supra* note 87, at 16.

148. "Controlled trading" is a term that applies to clean air policies which allow trade-offs in achieving emission reductions. Note, *Regulating with a Carrot: Experimenting with Incentives for Clean Air*, 31 BUFFALO L. REV. 193, 207 (1982) (overview of controlled trading); Comment, *Emission Offset Banking: Accommodating Industrial Growth with Air-Quality Standards*, 128 U. PA. L. REV. 884 (1980).

149. GAO REPORT, *supra* note 87, at 16.

150. *See id.* For a discussion of the history of the bubble policy, see Landau, *Chevron, U.S.A. v. NRDC: The Supreme Court Declines to Burst EPA's Bubble Concept*, 15 ENVT'L L. 285 (1985).

151. *See, e.g.*, GAO REPORT, *supra* note 87, at 16.

152. *Id.* at 17.

153. *See id.*

154. *See supra* note 74.

reductions at other plants in that same nonattainment area. An existing plant may also expand and offset its projected emissions by obtaining reductions at other plants. Previously, new plants were not allowed in a nonattainment area and existing plants in such an area that wanted to expand had to reduce their emissions in other parts of the same plant.[155]

Emission reduction banking[156] ties the bubble and offset policies together. When a plant's emissions fall below the level required by law, it receives emission reduction credits which it can "bank" for future use by that plant for sale to others.

4. Obstacles to a Free Market System Through Use of "Controlled Trading"

"Controlled trading" receives its name since the "trading" involved is limited by certain technology requirements of the Act such as NSPS,[157] LAER,[158] and BACT.[159] These restrictions require that new plants meet stringent emission controls even though it would be cheaper if they used one of the trading programs to achieve their emissions reductions. For example, suppose that an existing plant in a nonattainment area was going to expand. This plant would be required to meet LAER requirements even if the plant had previously obtained an emission reduction credit that could be used to offset the projected increase in emissions.

Other obstacles to a free market for air pollution rights are transaction and search costs.[160] Transaction costs are those costs incurred, for example, when a control agency and an industrial plant determine what offsets are necessary. Reconciling differences in estimates may be both time consuming and expensive. Search costs are those costs involved in discovering what pollution entitlements are available, who has them, and how much they cost. These costs may be due, in part, to the novelty of trading air pollution rights.[161] Also, uncertainty as to the possibility of a future tightening of

155. *See* Comment, *supra* note 148, at 938.

156. *See, e.g.*, GAO REPORT, *supra* note 87, at 157.

157. New Source Performance Standards. *See supra* note 72 and accompanying text.

158. Lowest Achievable Emission Rate. *See supra* note 85 and accompanying text.

159. Best Alternative Control Technology. *See supra* note 81 and accompanying text.

160. GAO REPORT, *supra* note 87, at 38-41.

161. *Id.* at 96-101.

emission controls might lead to hoarding of these entitlements.[162]

5. Overcoming Obstacles to a Free Market in Air Pollution Entitlements

The GAO has determined that the obstacles to implementation of the widespread use of controlled trading which would lead to a full-scale free market in trading air pollution rights are not insurmountable.[163] The GAO attributes many of the potential problems to the novelty of trading air property rights. Once trading becomes more common, these obstacles will be less burdensome. The major hurdle, however, is overcoming the NSPS, LAER, and BACT provisions of the Act. As a first step, these provisions should be modified: new sources of emissions should have the option of engaging in controlled trading free from the stringent requirements of these technological criteria.

Acid rain is a problem whose solution is particularly suited to free market trading because the nature of acid rain is such that the transaction costs, one of the obstacles of a free market approach, will be at a minimum.[164] Sulfur dioxide, because it is a widely dispersed pollutant, falls within the rubric of what the GAO calls a "global" pollutant. If a level of pollution is set so that the NAAQS are met in a large geographical area, then trading in air pollution entitlements among firms would be the same as trading in emission entitlements.[165] So, for example, if Plant A has reduced its emissions by five tons per year of SO_2 more than is required to meet the NAAQS, then it could sell that entitlement to Plant B (Plant B being located far away from Plant A) which wanted to have the right to emit five tons more per year of SO_2. Contrast that scenario with a situation where the pollutant emissions from one plant did not have the same effect on air quality as the emissions from another plant. If, from the example above, the increase of five tons per year of SO_2 had a very large impact on the air quality of Plant B's AQCR, then Plant B would be forced to buy air pollution entitlements that exceeded its five tons per pollutant increase.

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162. Plants might hold onto their entitlements just in case emission controls might be tightened in the future under a SIP revision. *Id.* at 45-46.

163. *Id.* at 96-101.

164. *Id.* at 37.

165. *Id.*

Trading would have to be conducted on a case-by-case evaluation of the requirements of an equivalent trade. Trading in air pollution entitlements would clearly be impractical for localized pollutants. However, since transaction costs are at a minimum for widely dispersed pollutants, free market trading in air pollution rights for the cause of acid rain appears quite feasible.

Flexibility in the choice of reduction methods must be permitted as part of this free market system to stop acid rain. The specification of the technology to be used when rolling back emissions as dictated by the current "command and control" approach of the Act would bring havoc. There are several alternatives to installing the high cost scrubber technology promoted by some legislators.[166] These alternatives include the use of low sulfur coal, physical and chemical coal cleaning, oil desulfurization, limestone injection multistage burners, fluidized bed combustion and low NO_x burners. But these alternatives are opposed by special interest groups. Miners in the Midwest, for example, are adamantly opposed to a switch by coal users to low sulfur coal because most of the low sulfur coal in the United States is mined in parts of Kentucky and West Virginia and in the western parts of the country.[167] The stifling effect on the economy that would occur by imposing the artificial market supports necessary for the continued use of high sulfur coal, for example, has consistently been shown to cause more harm than good.[168] Political reality indicates that although everyone in the country would be forced to pay higher electricity costs to keep the Midwestern miners employed, those costs are spread so thin when compared to the effect a free market approach would have on a very small group, such as Midwestern miners, that electricity customers are not as likely to protest vigorously as

166. *See, e.g.*, the bill proposed by Rep. Henry A. Waxman (D-CA), which would have levied a tax on the generation of electricy and required scrubbers on the 50 electric power plants with the largest sulfur dioxide emissions (H.R. 3400, 98th Cong., 1st Sess. (1983)).

167. *See* OTA REPORT, *supra*, note 1, at 50. The OTA estimated that a 10 million ton per year reduction in SO_2 emissions would lower employment by 20,000 to 30,000 in the high-sulfur coal areas while creating 15,000 to 22,000 new jobs in Eastern low-sulfur coal areas. *Id.*

168. *See, e.g.*, THE HERITAGE FOUNDATION, MANDATE FOR LEADERSHIP II: CONTINUING THE CONSERVATIVE REVOLUTION, 36 (1984); Weidenbaum, *Foreign Trade and the U.S. Economy: Dispelling the Myths*, CATO POL'Y REP., Jan.-Feb. 1986, at 1; N.Y. Times, Feb. 17, 1986, at 16, col. 1 (Import quotas on Japanese cars for the last two years cost U.S. consumers $300,000 for every job the quotas protected).

miners who may lose their jobs if the increases did not occur.

6. Summary

The costs of preventing acid rain are significantly less when a free market system of air pollution entitlements is used. Given the high costs that acid rain currently imposes on society, the potential savings (represented by the difference between the costs to society and the costs of control) increases with this type of free market trading. These savings will stimulate the economy, primarily by benefitting those industries currently threatened by acid rain.

The potential cost savings of implementing a free market system of air pollution entitlements are enormous. The GAO has estimated that industry could save between 40 and 90% of the current costs of meeting air pollution emission requirements. We are attaching a lead weight to the neck of our economy by not allowing industry to choose the least cost method of pollution control. An acid rain control program based upon a free market approach is more feasible than a similar program based upon the existing command and control approach of the Act.

V. A Proposal for Change

The suggestions made in this article can be implemented in various ways. The following proposal is one method of controlling acid rain that follows the moral and ethical principles stated earlier.

1. Implement a Free Market System for Trading in Air Pollution Entitlements. A free market system will keep the costs of a control program to a minimum while simultaneously achieving air quality goals. This market will allow controlled trading in place of the rigid requirements of NSPS, LAER, and BACT.

2. Allow a Flexible Approach to Emission Control Within a Free Market System. If industry is allowed to choose the least expensive means of reducing emissions, whether that method be coal switching, coal washing, or something else, the price of emission reductions will be kept to a minimum and the economy will be stimulated.

3. Establish an SO_2 Control Region That Encompasses a Large Geographical Area. A control region that included the eastern thirty-one states, for example, would keep transaction costs to a minimum. Since the GAO has determined that transaction costs can significantly affect the feasibility of the

implementation of a free market, it is important to keep these costs low.

4. Establish a Source-Based Pollution Emission Standard for SO_2 and NO_x. A source-based approach (similar to NSPS) is desirable because the current environmental quality approach of the NAAQS is ineffective in preventing acid rain.